

ESSENTIAL OILS OF PLANTS FROM HISPANIOLA:
1. THE VOLATILE WOOD OIL OF CINNAMODENDRON EKMANII
(CANELLACEAE)

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Adams, Robert P. (Box 423, Baylor University, Waco, TX 79798, USA) and Zanoni, Thomas A. (Jardín Botánico Nacional "Dr. Rafael M. Moscoso", Apartado Postal 21-9, Santo Domingo, Dominican Republic). Essential oils of plants from Hispaniola: 1. The volatile wood oil of *Cinnamodendron ekmanii* (Canellaceae). Moscosoa 5: 154-158. 1989. The volatile oil from the wood of *Cinnamodendron ekmanii* Sleumer (Canellaceae) was analyzed by fused silica capillary gas chromatography/ ion trap mass spectroscopy (GC/ITMS). The wood yielded 0.20% (oven dry wt basis) of volatile oil. The oil is dominated by 1,8 cineol (35.9%) with moderate amounts of α -humulene (9.1), β -caryophyllene (6.5), 4-terpineol (5.0), germacrene D (4.9), β -elemene (4.8), β -pinene (3.6) and α -terpineol (3.0). A total of 48 components were identified and reported. No unknown components greater than a trace (0.5%) of the total oil were found. The components typical of cinnamon wood oil (cinnamaldehyde, cinnamyl acetate) were not found contrary to the implication of the generic name (*Cinnamodendron*).

A wide variety of aromatic plants occur on Hispaniola. Neither the composition nor yields of most of these species has been examined. This study of the volatile wood oil of *Cinnamodendron ekmanii* is the first in a series in which the essential oils of aromatic, and especially endemic, species from Hispaniola will be reported. New sources of spices and essential oils will also be investigated from among the endemic species. In addition, the potential for the introduction of commercial spice and essential oil crops will also be investigated to determine the influence of soil and climate on the quantity and quality of the products.

Cinnamodendron ekmanii is endemic to Hispaniola (the island that includes the Dominican Republic and Haiti) and is only known from karst limestone regions in the northeastern corner of the Dominican Republic. The distribution is limited to the geographic regions of the Samana Peninsula, Los Haitises, and the eastern extreme of the Cordillera Septentrional. Specimens examined are: REPUBLICA DOMINICANA: Peninsula de Samaná: Prov. Samana: Laguna, in Loma Zaramagua, light forest, elev. 250 m, "occurs in all limestone mountains east of Río San Juan," *Ekman H-14975* (Holotype & Isotype, S); cerca del poblado El Escarbado (N de La Majagua), límite del oeste de la sierra de la península y de la Loma de Majagua, sobre roca de caliza, elev. 30 m, *Zanoni et al. 29978* (JBSD), *Zanoni et al. 24686* (JBSD); en el bosque en el paso de Loma Pan de Azúcar, La Laguna, elev. 300-440 m, *Zanoni et al. 31188* (JBSD); Cordillera Septentrional: Prov. Puerto Plata: en bosque, El Choco (de) Cabarete, alt. 50 m, *A. & P. Liogier 26495* (JBSD); 1.8 km al Suroeste de Cabarete en un sendero viejo a El

Choco, sobre un mogote de caliza, *Zanoni & Gentry 34119* (JBSD, NY, voucher for chemical study), *Zanoni & Gentry 34124* (JBSD, NY); Los Haitises: Prov. El Seibo: Bahía de San Lorenzo, en el Cayo "Come Queso" al Oeste de Cueva de Arena, alt. 5m, *Mejía et al. 1558* (JBSD); fuera de la Cueva de Arena, frente a la Bahía de San Lorenzo, roca calcarea, elev. 0–10 m, *Zanoni et al. 35976* (JBSD); aprox. 20 min a pie desde la caseta de guardaparques de Monte Bonito en el sendero a Pilancón, bosque latifoliado, zona húmeda, *Zanoni et al. 36218* (JBSD).

Cinnamodendron ekmanii is a component of the understory of the natural forest cover of the karst terrain that has been severely altered by deforestation. The sites have very little accumulation of mineral soil; the substrate is principally rock and organic material. The removal of the forest cover and subsequent burning of the sites destroys the "soil" in large part. In our observations, younger plants still exist in the sites visited, but few small trees have been seen.

Materials and Methods

Wood of *C. ekmanii* and a voucher specimen (*Zanoni 34119*) were collected from near Cabarete, Dominican Republic in April, 1985. A herbarium voucher specimen is on deposit at JBSD. Wood stems of approximately 2 cm in diameter were cut into 1 cm sections and these were then split into 4 pieces to increase the surface area during steam distillation. The volatile wood oil was extracted by steam distillation for 14 h in a circulatory steam distillation apparatus using diethyl ether as a floating solvent trap (Adams 1975). The ether was removed from the oil by use of a jet of nitrogen, then tightly sealed in a glass vial with a foil-lined cap and stored at -20°C until analyzed.

Mass spectra were recorded with a Finnigan Ion Trap (ITD) mass spectrometer model 700 directly coupled to a Varian 6500 gas chromatograph, using a J & W DB5, 0.25 mm \times 60 m, 0.25 micron coating thickness fused quartz capillary column. The GC/ITD was operated under the following conditions: injector temperature: 180°C ; temperature programmed: $60\text{--}240^{\circ}\text{C}$ @ $3^{\circ}/\text{min}$; carrier gas: He @ 22.9 cm/sec (60°C), 19.1 cm/sec (220°C); 0.1 μl (20% soln), split 1:50. Tuning values for the ITD were 40, 48, 85, 95 using cedrol as a tuning standard. Cedrol is well-suited for tuning the ITD because its mass spectrum is very sensitive to changes in tuning values. n-octane, n-eicosane and hexadecyl acetate were added as internal standards.

Quantification was made by FID using a DB5 column (see above) in a

Varian 6500 gas chromatograph with He as the carrier gas with an average linear velocity of 15 cm/sec (60°C); 18 cm/sec (220°C); 0.1 μ l (20% soln.), split 1:30, temperatures as above, except the FID operated @ 240°C. Identifications were made by comparisons of the mass spectrum of each component in the oils with those of the known terpenes and by computer searches of spectra from the Finnigan library based on the National Bureau of Standards (NBS) data (Adams, et al., 1979) and a newly created library of terpenoids on the ion trap. Relative retention times (RRT hexadecyl acetate = 1.00) were also compared with the RRT of known terpenoids run under the same conditions. Peak areas were quantitated using a Columbia Scientific Industries Supergrator-2 electronic digital integrator.

Results and Discussion

The yield of volatile oil from the wood was 0.20% (dry wt basis). The composition of the wood oil is reported in Table 1. A total of 48 compounds were identified and reported (Table 1). Several unidentified trace components (less than 0.5 % of the total oil) were found and are not listed in Table I. The oil is dominated by 1, 8 - cineol (35.9 %) with moderate amounts of α - humulene (9.1), β - caryophyllene (6.5), 4 - terpineol (5.0), germacrene D (4.9), β - elemene (4.8), β - pinene (3.6) and α - terpineol (3.0). In addition to the terpenoids from the mevalonic acid pathway, several aromatic compounds were found which come from the phenyl propanoid pathway (eugenol, methyl eugenol and safrole), but these were minor components in this oil (Table 1).

The wood of *Cinnamodendron ekmanii* is said to have a cinnamonlike or 'spicy' aroma when freshly cut. The compounds responsible for the aroma of commercial cinnamon bark (*Cinnamomum* spp.) are cinnamaldehyde and cinnamyl acetate (Lawrence, 1980). A search for these two compounds in the oil of *Cinnamodendron ekmanii* failed to discover even trace amounts. It is possible that the aromatic components degraded before analyses, although both cinnamaldehyde and cinnamyl acetate appear to be stable in commercial cinnamon bark. Alternatively, the cinnamon-like aromas released upon cutting the wood may be due to the mixing of enzymes from the cambium with the volatile oil and subsequent reactions. It might be noted that Senanayake et al. (1977) showed that eugenol and cinnamaldehyde are synthesized from the phenyl propanoid pathway (probably phenylalanine as the precursor). The presence of eugenol, methyl eugenol and safrole (all from the phenyl propanoid pathway) in *C. ekmanii* oil (table 1) indicates that the precursors for cinnamaldehyde are present.

TABLE 1. Composition of the volatile wood oil of *Cinnamodendron ekmanii*. Compounds are listed in order of their elution from a D85 column. Compound names in parenthesis are tentatively identified. T indicates the compound is present in a trace amount (less than 0.5% of the total oil).

COMPOUND	% Total oil	COMPOUND	% Total oil
α -Thujene	T	Safrole	T
α -Pinene	2.10	α -Terpineol acetate	2.28
Camphene	T	α -Cubebene	T
Sabinene	2.72	Eugenol	T
β -Pinene	3.59	α -Copaene	T
Myrcene	1.12	β -Bourbonene	T
α -Phellandrene	T	β -Elemene	4.82
α -Terpinene	0.96	Methyl eugenol	1.11
p-Cymene	1.87	β -Caryophyllene	6.51
Limonene	2.41	α -Humulene	9.16
1,8-Cineol	35.88	Germacrene isomer 3	T
γ -Terpinene	1.15	Germacrene D	4.87
(cis-p-menth-2-ene-1-ol)	T	(trans-Methyl isoeugenol)	T
p-Cymenene	T	(β -Selinene)	T
Terpinolene	0.55	(α -Selinene + γ -Elemene)	0.82
Linalool	T	γ -Cadinene	T
Camphor	T	δ -Cadinene	0.70
δ -Terpineol	T	Elemol	1.81
4-Terpineol	5.02	Caryophyllene oxide	T
(p-Cymen-9-ol)	T	r-Eudesmol	T
α -Terpineol	3.02	γ -Cadinol	T
cis-Piperitol	T	β -Eudesmol	0.50
trans-Piperitol	T	α -Eudesmol	T
Bornyl acetate	T		

Literature Cited

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